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ABraytCSPfuture

Air-Brayton Cycle **C**oncentrated **S**olar **P**ower **future** plants via redox oxides-based structured thermochemical heat exchangers / thermal boosters

Deliverable D1.2.
Quality Management Plan

Dissemination Level: Public

WP1 Project coordination and management

Date: 15.02.2023

DLR
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https://www.abraytcspfuture.eu/

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Disclaimer

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About the Project

ABraytCSPfuture sets forth an innovative, carbon-neutral way for implementing the highly efficient air-Brayton gas turbine power generation cycles into future air-operated Concentrated Solar Power (CSP) plants. Air-Brayton cycles are used in traditional power plants where, however, involve fossil fuels combustion via pressurized air. *ABraytCSPfuture*'s carbon-neutral approach aims at achieving higher solar-to-electricity efficiencies, vital for competitiveness of CSP and non-reachable by either PVs or molten salts and thermal oils, increasing in parallel significantly the plants' storage capability. The project will develop and demonstrate a first-of-its-kind compact, dual-bed thermochemical reactor/heat exchanger unit that will transfer heat from a non-pressurised air stream to a pressurised one, while also operating as a thermal booster, raising the temperature of the pressurized stream to the level required for Brayton cycles. Furthermore, the volumetric solar energy storage density of air-operated CSP plants will be significantly increased by rendering their current sensible-only regenerative storage systems to hybrid sensible-thermochemical storage ones within the same storage volume. Both these functionalities will be materialized by thermochemical reactor/heat exchanger units comprised of non-moving, flow-through porous ceramic structures (honeycombs or foams) based on earth-abundant, cost-efficient, non-toxic oxide materials and exploiting reversible reduction/oxidation reactions of such oxides in direct contact with air, accompanied by significant endothermic/exothermic heat effects. The proposed technology is set forth by an interdisciplinary partnership spanning the entire CSP value chain, comprised of leading research centres, universities, innovative SMEs and large enterprises, including ancillary services providers and technology end-users.

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COBRA Instalaciones y Servicios S.A., **COBRA**	ES	

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This deliverable is part of a project that has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement no 1010845.

Executive Summary

The present document constitutes Deliverable D1.2 "*Quality Management Plan*" developed within WP1 of the HORIZON EUROPE 2020 ABraytCSPfuture project. It includes the necessary quality planning provisions and guidelines to be adopted by the partners in order to ensure that ABraytCSPfuture project is implemented smoothly and all its deliverables are of high quality and are submitted to the EC services on time.

A thorough quality procedure has been established concerning the project's deliverables and reports: each project deliverable will be quality-reviewed by at least one internal reviewer (member of the consortium), as well as by the Project Coordinator before being submitted to EU's funding agency. The procedure is targeted on ensuring that the submitted deliverables adequately satisfy the quality criteria of clarity, completeness, accuracy, relevance, and technical compliance. Relevant quality assurance procedures are going to be implemented also for the project reports as well as dissemination materials.

Finally, a risk management plan is put into place, consisting of the identification of the technical (research-oriented) and management (project implementation-related) risks and the mitigation actions to be employed per case.

Changes with respect to the DoA

Deliverable *D1.2 Quality Management Plan* was erroneously foreseen due on Month 48 of the project. The Deliverable is submitted on Month 3, at the same date as Deliverable *D1.1. Project Management Plan with Gantt chart and Work Breakdown Structure,* with which is strongly linked.

1. Introduction

Deliverable *1.2. Quality Management Plan (GMP)* is produced within the Management and Coordination work package (WP1) with the purpose of outlining the approach to be adopted during the project in order to ensure that tasks are completed on time and high performance/quality of results of the project is guaranteed. The document is based on the Description of Work (DoW) in the proposal and its modifications during the Grant Agreement preparation procedure, as well as on the discussions during the project kick-off meeting on Nov. 30th and Dec. 1st, 2022. It is in close conjunction with *Deliverable 1.1. Project Management Plan (PMP),* within which the project management bodies and their roles and responsibilities are defined and the internal communication plan, Deliverables and work breakdown schedule are analytically described.

In this context, the specific objectives of this deliverable are to:

- establish the processes for ensuring the quality of the project deliverables and reports,
- analyse the potential risks of the project that may jeopardise quality and evaluate their impact;
- proactively define planned risk mitigation measures to guarantee proper execution of the project's tasks.

In order to ensure its relevance throughout the lifetime of the project, the QMP will be revisited regularly and updated when deemed necessary.

2. Quality Assurance of Project Reports

As described in D1.1, the project is divided into three reporting periods (RPs):

- RP1: from Month 1 to Month 16 (i.e. November 1, 2022 – March 31, 2024).
- RP2: from Month 17 to Month 32 (i.e. April 1, 2024 – July 31, 2025).
- RP3: from Month 33 to Month 48 (i.e. August 1, 2025 – November 31, 2026).

Within 60 days from the end of each RP, a Report must be submitted to the granting authority by the PC, i.e. two Periodic Reports and a Final Report are due in total; they are mandatory and linked to interim and final payments by the granting authority.

The periodic and the final reports contain

(a) a "periodic technical report",

(b) a "periodic financial report".

The requirements and contents for each one are described in the Grant Agreement. It is important to stress that whereas the PC is responsible for uploading the "periodic technical report", the "periodic financial report" and the relevant cost statements of the partners and their uploading remain a sole responsibility of each beneficiary.

The continuous reporting module in the EC participant portal was activated at the date the project started and is continuously open to submit deliverables and report on milestones etc. Following the end of each reporting period the functionality of periodic reporting in the Participant Portal will be activated. The latter will allow each participant to complete on-line their own Financial Statement and allow the Project coordinator to upload the respective period's technical report. Final versions of Periodic Reports will be uploaded and saved to the Data Repository. The procedure and timing for the preparation and review to ensure high quality of the reports consists of the steps outlined in Table 1.

Table 1: Process for the delivery of project's official periodic reports.

When	Who	What	Recipient
1 day after the end of the reporting period	Project Coordinator	Asks the task leaders to provide all relevant technical data, information and input to the respective WP leaders within two weeks.	Task Leaders (and all partners).
15 days after the end of the reporting period	Task Leaders	WP leaders have all necessary technical data, information and input from their WP tasks.	WP leaders
25 days after the end of the reporting period	WP leaders	WP leaders consolidate their WP tasks data, articulate their WP report into the relevant periodic report template and send it to the PC. PC asks all partners to start preparing the financial report.	Project Coordinator
40 days after the end of the reporting period	Project Coordinator	PC synthesizes draft periodic report from relevant WP leaders' data and sends it to the partners for reviewing.	All partners
45 days after the end of the reporting period	All partners	Reviewers (all partners) send comments to the PC as a Track Changed document. The Reviewers are responsible for performing Quality Assurance whereby the document will be assessed according to specific quality criteria.	Project Coordinator
50 days after the end of the reporting period	Project Coordinator	The PC sends the revised document to all partners for final review. If in the case the document fails to match the QA criteria, the GA will be notified and will set out steps to be taken to improve the report's quality.	All partners, General Assembly (GA)
40-55 days after the end of the reporting period	All partners	Provide their own financial statements and upload it in the participants portal	EC
55-59 days after the end of the reporting period	All partners Project Coordinator	Reviewers confirm document is accepted. PC puts together the Final version of Part B of the report and submits it to the participant portal.	EC

3. Quality Assurance of Project Deliverables

As a part of the Quality Management Plan, the consortium will apply an internal reviewing procedure to guarantee the quality of its results. Each WP leader will be responsible for the quality of the results, especially of the deliverables, which will be subjected to a peer review by another member of the project team. Before its submission, each project deliverable will be quality-reviewed by at least one internal reviewer (member of the consortium partners). In general, the PC will invite all consortium partners to declare their interest in reviewing the upcoming deliverables for the next six months, and then will allocate the reviewers based on the declared interest, the partners technical expertise and overall availability. However, the general idea is that, if possible, the reviewer should not be involved at all with the WP that the specific deliverable is associated with, so that can provide a "sort-of-third-party" assessment and criticism. On the other hand, naturally, the reviewer should have a relevant technical expertise on the topic under review. Therefore, in cases where it would be not possible to identify a suitable reviewer outside the Deliverable's WP, i.e. in Deliverables or WPs where most or all partners are participating, the Deliverable draft will be forwarded to all parties. With the rationale above, the following, tentative list of allocation of reviewers per Deliverable as per Table 2, has been assembled. Naturally, the list can be subjected to change in the course of the project, depending on partners' involvement, technical expertise, availability etc. In any case, the steps above should take place early enough before the deliverables submission due date to secure its timely submission.

The quality of the deliverables will be assessed against specific quality criteria in order to ensure uniformity and consistency in the review process of all deliverables and to ensure the reviewers' clear understanding of and compliance with the process. Given that most of the Deliverables are Public, attention should be paid by both the primary authors as well as the reviewers (criteria for evaluation) of the Deliverables to the following points:

- The language of the text is clear, unambiguous and useful to the targeted audience (e.g. scientists, policymakers, etc.) and there are no spelling errors.
- The terminology, including acronyms is explained.
- Any potentially sensitive information is appropriately worded to safeguard the interest of the involved consortium partners.
- Credit to all prior work cited is acknowledged with respective references.
- The content is relevant to the scope of the deliverable and all aspects of the deliverable as described in GA-A1are fully addressed.

In case where the EC would request a revision of a submitted Deliverable, the internal review process will be repeated.

Table 2: First tentative allocation of internal reviewers to project deliverables.

No	Deliverable name	Responsible partner	Reviewer partner
D1.1	Project management plan	DLR	CERTH
D1.2	Quality management plan	DLR	All
D2.1	Computationally-screened shortlisted redox compositions for further research.	DLR	UT
D2.2	Powder redox-relevant properties variation with temperature and pressure.	DLR	KB
D2.3	Thermochemical properties variation with temperature.	CERTH	FHG
D2.4	Optimized redox oxide powder formulations for model ceramic pieces manufacture	CERTH	LET
D3.1	Properties of structured ceramic model specimens as a function of temperature.	CERTH	CENER
D3.2	Optimal porous structures for combined TCS/thermal booster operation based on combined activity, thermo-mechanical stability and cyclability performance	CERTH	TEKN
D3.3	Optimized redox oxide formulations and structured objects for proof-of-concept-scale unit.	CERTH	UT
D4.1	First/final version of chemical/transport processes simulation results in redox structures.	UT	TEKN
D4.2	First/final version of simulation results of redox structures thermochemical expansion	DLR	UT
D4.3	Structured objects geometries and design of dual-bed unit for integrated TCS /thermal booster operation	TEKN	UT
D4.4	Complete flowsheet and Piping & Instrumentation diagram.	DLR	CERTH
D4.5	Process control scheme of STPP-scaled-up dual-bed unit.	TEKN	DLR
D4.6	Complete flowsheet/analysis of optimized STPP-level integrated process	CENER	DLR
D5.1	Optimized redox powders scaled-up powder synthesis/processing protocols.	CERTH	FHG
D5.2	Proof-of-concept high-oxide-content porous structured objects shaping/sintering protocols.	LET	CENER
D5.3	Dual-bed storage prototype unit assembled, manufactured and installed on test rig facility.	KB	CENER
D6.1	Report with results of extended in-service “thermal booster” operation campaigns	DLR	UT

D6.2	Report on in-service degradation of functional materials after longer-term cyclic operation and its impact on overall performance of technology components and systems.	CERTH	FHG
D6.3	Report with final evaluation of technology vs. key performance indicators set.	DLR	COBRA
D7.1	Report on environmental-friendly materials selection	FHG	UT
D7.2	Key stakeholders' meetings identifying environmental/ social/economic impacts.	FHG	CENER
D7.3	LCA study, socio-economic and environmental impact.	FHG	UT
D7.4	Technology scale-up prospects, business cases and required policy framework	COBRA	FHG
D8.1	Launch of project's website, protected acronym, electronic communications network and social media account.	CENER	DLR
D8.2	Data Management Plan	DLR	CENER
D8.3	Dissemination and exploitation plan and updates	DLR	LET
D8.4	Preliminary market study for proposed technology	CENER	COBRA
D8.5	Workshop on project's final achievements	DLR	CENER
D8.6	Dissemination/exploitation activities and post-project plan.	DLR	COBRA
D8.7	Virtual Reality tool for dissemination of project results.	DLR	CENER

4. Quality Assurance of Dissemination Materials

The other scientific and policy-related outputs of the project, i.e. the project commentaries, newsletters, briefs and working documents, will also be reviewed before they are published, mainly for compliance with the respective templates. As there are no deadlines and no formal submission for these materials, the process only includes delivery of the draft document by the dissemination leader, based on the inputs of the authors, and a technical check by the Project Coordinator.

Templates will also be developed for other, communication-related, project material (e.g. newsletters and press releases). For this type of resources, the *WP8 Knowledge and innovation management, dissemination, communication and European innovation base development* Leader together with the Project Coordinator, will be reviewing the content of every produced resource for completeness and its format for compliance with the respective template.

The quality assessment of these materials will be performed against the performance indicators set under the expected policy, societal, and research/scientific impacts reflected in Annex I (Part B) of the Grant Agreement and Listed in Table 3.

Table 3: Targeted Key Performance Indicators for Dissemination and Communication material of ABraytCSPfuture.

Dissemination and communication targets		
Activity/Deliverable	**Target / KPIs**	
Open access Publications in scientific journals	At least 20.	
Presentations at international conferences	At least 20 presented in either physical or online events subjected on developments on Covid-19/pandemic.	
Project website	Number of visits Downloads of public deliverables	≥ 3000 ≥ 200
Flyers distributed at conferences, workshops	≥ 1000	
Newsletters	6 **newsletters** (1 every 8 months),	
Workshops	≥ 2 with a**t least 50 participants**	
Twitter	At least 200 followers by the end of the project	
Linkedin	Creation of account; at least 70 followers by end of project	
Videos	At least 1	

5. Risk Analysis

Considering the above time frame and list of milestones, the consortium has already analysed and identified the risks and conceived respective mitigation actions as summarized in Table 4 below. Naturally, the assessment of those or any other upcoming risks and the decision on mitigation measures will constantly take place during the project. As already mentioned, the challenges and associated risks can be categorized to the materials development ones and to those relevant to the device level and its operation.

Table 4: ABraytCSPfuture risk analysis and relevant mitigation actions.

Description of risk	WP	Likelihood	Impact	Proposed risk-mitigation measures	Likelihood after mitigation
Technological and scientific risks					
Structures made entirely of earth-abundant, non-critical redox oxides do not meet the long-term chemical/thermo-mechanical lifetime criteria.	2 3 6	Medium-to-high	Medium-to-high	"Dilution" of redox oxide compositions with "inert" materials to induce rigidity, i.e. shift to "redox-material-containing composites". Redox oxide compositions to be post-coated on chemically inert, porous substrates (e.g. cordierite) of appropriate morphologies and geometries.	Medium
Conceptual and final design of integrated storage reactor/heat exchanger cascade cannot implement satisfactory cyclic operation.	6	Medium	Medium	Substantial experience of the consortium partners on the design and manufacture of analogous structured reactors, with construction modularity and minimum system complexity. <u>Fall-back options:</u> System design by increasing contribution of sensible storage.	Low-to-medium
Inability of TCS/regenerator system to provide pressurised air at the required TIT (min. 950 °C) and consequent issues related to integration with air Brayton cycles.	6	High	High	Long-term validation of redox specimens scheduled in T5.3 will provide relevant information early in the project allowing potential corrective action. Measures will include: a) increase of storage system sizing; b) slight further increase of air temperature provided. Combination of such measures already assessed as feasible.	Medium
Cost targets in terms of LCOE and/or shaped structures from inexpensive raw materials not fully met.	7	Medium-to-high	Medium	WP7 plan in project's start ensures integration scenarios shortlisting based on relevant cost targets and boundaries definition of potential cost-defining components. Basic relevant strategies already defined in previous projects.	Low-to-medium

Insufficient time for detailed experimental evaluation of the hybrid sensible-TCS reactor in test platform due to delays in components procurement/manufacturing.	6	Low	Medium	A sufficient duration of 9 months is scheduled for the relevant WP6 campaign. 48-month project duration ensures ample time for required developmental and design of integration activities. Even if delays cause reduction of testing time to 6 months, this is still sufficient for reliable experimental proof-of-concept validation.	Low
Project management risks					
Schedule delays	ALL	Low to medium	High	9-monthly progress monitoring to anticipate/mitigate any severe delays; project duration set at 48 months to absorb them. The Synlight® solar simulator test platform provides for **at least 6 months** testing **without depending on weather conditions**.	Low

6. Conclusions

Following the project kick-off meeting, a Quality Management Plan (QMP) for the project has been drafted, in close conjunction with the Project Management Plan (PMP). The QMP describes the approaches to be adopted by the partners in order to ensure that the project is implemented smoothly and all its deliverables are of high quality and submitted to the EC on time.

Basically, the approach involves timely internal reviewing of the project's deliverables and reports by at least one internal reviewer as well as by the suitable project's management bodies before being submitted to EU's funding agency.

This work breakdown structure and the global timeline of the project allow to identify some initial risk issues in its course which is particularly important at this early stage in order to consider and prepare mitigation strategies and fall-back options to ensure timely completion of all deliverable and milestones. Hence, a risk management plan is put into place, consisting of the identification of the technical (research-oriented) and management (project implementation-related) risks and the mitigation actions to be employed.